Hi-C Observations of Penumbral Bright Dots

S. E. Alpert

Department of Physics and Astronomy, Rice University, Houston, TX, 77005, USA

NASA MSFC and UAH REU

and

S. K. Tiwari, R. L. Moore, S. L. Savage, and A. R. Winebarger

NASA Marshall Space Flight Center, ZP 13, Huntsville, AL 35812, USA

Abstract

We use high-quality data obtained by the High Resolution Coronal Imager (Hi-C) to examine bright dots (BDs) in a sunspot's penumbra. The sizes of these BDs are on the order of 1 arcsecond (1") and are therefore hard to identify using the Atmospheric Imaging Assembly's (AIA) 0.6" pixel^{-1} resolution. These BD become readily apparent with Hi-C's 0.1" pixel^{-1} resolution. Tian et al. (2014) found penumbral BDs in the transition region (TR) by using the Interface Region Imaging Spectrograph (IRIS). However, only a few of their dots could be associated with any enhanced brightness in AIA channels. In this work, we examine the characteristics of the penumbral BDs observed by Hi-C in a sunspot penumbra, including their sizes, lifetimes, speeds, and intensity. We also attempt to find any association of these BDs to the IRIS BDs. There are fewer Hi-C BDs in the penumbra than seen by IRIS, though different sunspots were studied. We use 193 Å Hi-C data from July 11, 2012 which observed from ∼18:52:00 UT–18:56:00 UT and supplement it with data from AIA's 193 Å passband to see the complete lifetime of the dots that were born before and/or lasted longer than Hi-C's 5-minute observation period. We use additional AIA passbands and compare the light curves of the BDs at different temperatures to test whether the Hi-C BDs are TR BDs. We find that most Hi-C BDs show clear movement, and of those that do, they move in a radial direction, toward or away from the sunspot umbra. Single BDs interact with other BDs, combining to fade away or brighten.

The BDs that do not interact with other BDs tend to move less. Many of the properties of our BDs are similar to the extreme values of the IRIS BDs, e.g., they move slower on average and their sizes and lifetimes are on the higher end of the IRIS BDs. We infer that our penumbral BDs are the large-scale end of the distribution of BDs observed by IRIS.

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